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12 October 1954

MEMORANDUM FOR: Director Central Intelligence**SUBJECT: Sound Modulation**

1. Attached is a description and some simplified sketches of some new theories on sound fabrication and modulation that I have developed as a hobby.

2. As will be noted in the attached document a great deal of work has been expended by Bell Telephone Laboratories and others along these general lines, however, they have never accomplished exactly what I have in mind.

3. If the theories that I have outlined in paragraph 7 of fabricating sound by drawing the proper serrations on film strip material to produce any sound or speech desired is practical, it could be useful to CIA. For example -- after samples of any particular individual's speech is analyzed a sound film strip could be fabricated and made to say anything desired and it would have the word pronunciation characteristics of the individual's voice. Listeners who know the individual's voice would believe it was he who was doing the talking.

4. Prior studies have shown that every person's voice will produce a different light configuration pattern on sound film strips for the pronunciation of the same word or syllable. I believe these variations can be produced manually and that sound strips can be fabricated to say anything desired and sound like the voice of any person desired when sufficient samples of his speech have been analyzed.

5. If this theory is practical its value in both peace and war is obvious.

6. I would like to know if CIA is interested. If not interested a negative report is requested.

7. It is requested that attachment not be discussed outside CIA.

Attachment: As indicated above
(single copy only)

DOCUMENT NO. _____
NO CHANGE IN CLASS. ☐
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CLASS. CHANGED TO: TS S *C2011*
NEXT REVIEW DATE: _____
AUTH: HR 70-2
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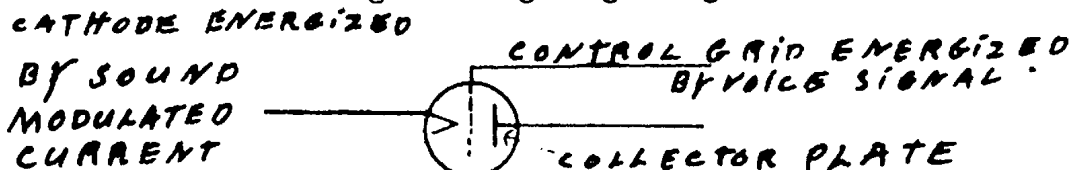
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SOUND MODULATING EQUIPMENT

1. The purpose of this equipment is: (1) To receive an audible sound of any quality or pitch and by modulating it properly reproduce it in a loud speaker as enunciated and understandable words. (2) electronically fabricate sound of any quality, pitch or modulation required or desired.

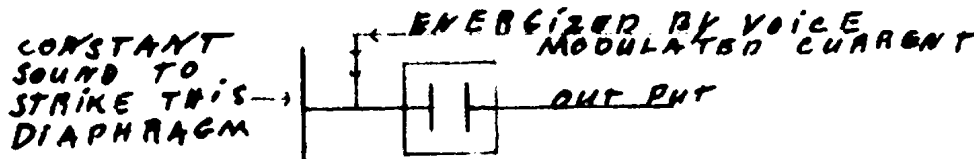
2. The electronic modulation of sound to produce enunciated words may be accomplished by the following circuits:

- A. The electron emission potential of the cathode of a triode vacuum tube is energized by a current that is created or modulated by a continuous or any desired sound. A voice produced signal is connected to the control grid of the vacuum tube. Thus the sound modulated electron flow from the cathode to the plate is further modulated by the voice signal in the control grid. The resulting signal passing through the plate, when amplified in a loud speaker will have the quality of the continuous sound modified to be heard as enunciated words in accordance with the signal energizing the grid.



The above circuit may be varied by introducing the continuous sound modulated energy into either the control grid or plate and the voice modulated energy into either the cathode or plate to achieve the desired sound effects. A desired effect may also be achieved by energizing the suppressor grid of vacuum tubes with a voice modulated energy.

- B. A constant sound may strike the diaphragm of a carbon or electromagnetic microphone that is energized by a voice modulated current. The result will be a signal with the quality of the continuous sound modulated by the voice modulated current.



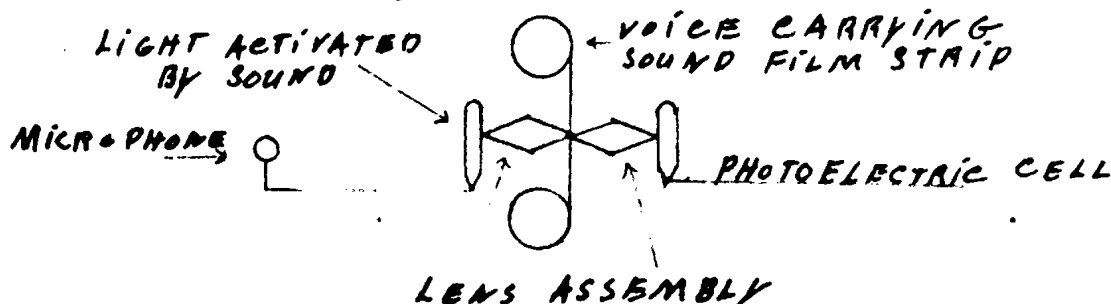
The modulation may be accomplished as shown above or the constant sound may energize the microphone with the voice striking the diaphragm whichever sound effect is desired.

- C. A constant signal may be introduced into the coil of an electromagnetic speaker. If the electromagnet of the speaker is energized by a voice modulated energy the cone and coil of the speaker will vibrate with the quality of the constant signal but modulated by the voice signal.

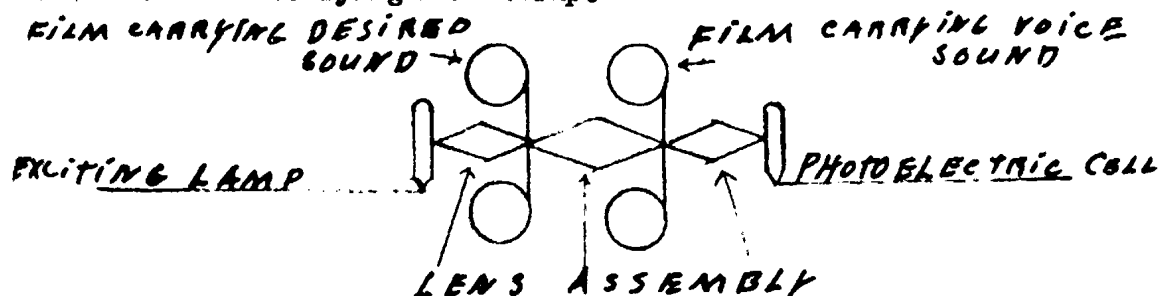


3. Objectives (1) and (2) as stated in paragraph one above may both be accomplished by the use of sound film strips and photoelectric cells. The following methods and circuits can be utilized to produce enunciated words from another sound:

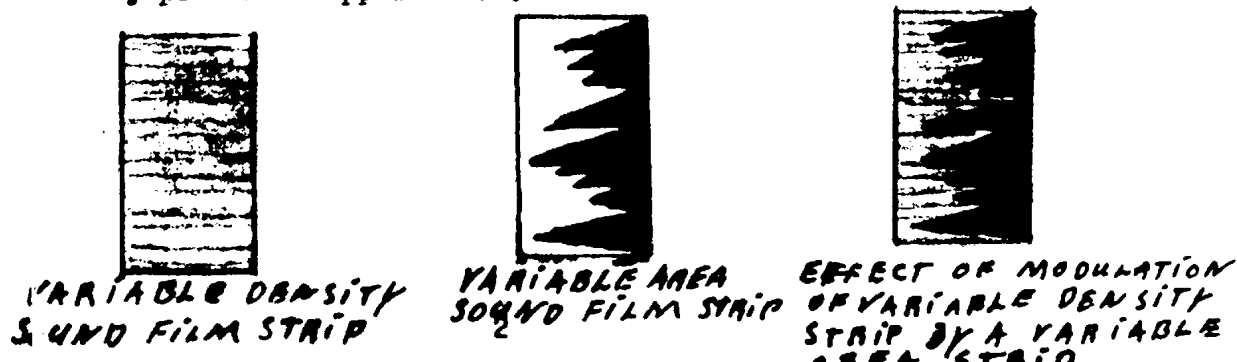
- A. A continuous or other desired sound can be made to activate a light such as the AEO light. If this sound modulated light source is permitted to directly activate a photoelectric cell the resultant electric impulses may be amplified and the original sound reproduced in a loudspeaker. If a voice carrying sound film strip is introduced between the original modulated light and the photoelectric cell whereby the light produced by the continuous sound must pass through the voice sound strip the resultant light striking the photoelectric cell will generate a signal with the quality of the original sound modulated by the voice sound strip.



- B. An exciting light can be focused through a sound film strip that is carrying a constant sound. This modulated light will again be focused through a sound film strip that carries a voice. When this modulated and remodulated light strikes a photoelectric cell a signal will be produced that has the quality of the original sound but is modulated in accordance with the voice carrying film strip.



The relative merits of using sound film strips made by the variable area method or the variable density method of putting sound on film or a combination of the two would be determined by practical application.



4. It is to be noted that speech has dual characteristics. One is the high frequency of the fundamental sound and the other is the low frequency syllabic modulation of this sound by the movable parts of the human vocal system.

5. In the production of the voice carrying sound film strip it may be found desirable to ~~eliminate~~ the high fundamental frequency and leave only the low syllabic frequency impressed upon the voice modulating film strip as shown in the example below of a high frequency variable density sound strip being modulated by a syllabic frequency variable area sound strip.



6. This syllabic frequency sound film strip may be produced in two ways. (1) Exposing the raw film strip by a light that is activated by a syllabic frequency. (2) Fabricating by hand a sound film strip with the proper syllabic frequency serrations using the variable area method.

7. Sound film strips can be fabricated by hand and sound of any quality, pitch or modulation required or desired may be produced. Pursuant to this objective, conventional sound film strips of the variable area type, of various sounds and speech, can be magnified, studied and analyzed and the general light configurations or serrations produced on the film by the various sounds can be established. After such general designs have been established a draftsman or artist can draw, on transparent film strip material, proper serrations to produce any desired or required sound or modulation thereof when this when this fabricated sound film strip is passed between a light and lens system and a photoelectric cell that is properly connected to an audio-amplifier and a loudspeaker. It must be noted that the width of the fabricated sound film strip would be determined by practical application, however, it can be judged by the magnification required to enable study of conventional sound strips.

8. Prior studies in the theory of sound have laid a good ground work upon which the future of sound fabrication can be based. A great deal of work has been devoted to perfecting methods of reproducing and mixing sounds by mechanical and electrical means. However, the field of the fabrication of sound has barely been touched.

9. Purity and pleasantness of musical sound has, heretofore, been limited to musical instruments of fixed mechanical construction and to a lesser extent electric oscillators plus man's manipulation of these instruments. The beauty and variety of sounds thus produced is not questioned but it would be extremely shortsighted to assume that the ultimate has already been achieved in the production of sound that is pleasing to the ear or sounds that arouse other human emotions.

10. By using the method of painting the required serrations on transparent film the possibilities for the fabrication of sound is limited only by the imagination and creativeness of the technicians and artists.

11. A preliminary search has been made in the U.S. patent office to determine the relation of this disclosure to prior patents. It was found that Patent No. 2,151,091 issued March 21, 1939 to H.V. Dudley, Garden City, New York, assignor to Bell Telephone Laboratories, provided for the transmission of unintelligible voice signals that could be reproduced into intelligible voice signals at the receiving end. The primary object of the Dudley invention was to reduce the frequency range required for the transmission of speech and the secrecy of such unintelligible signals from interception.

12. Dudley based his invention on the fact that speech has dual characteristics. One is the high frequency fundamental sound and the other is the low syllabic frequency. He has divided the low syllabic frequencies into ten parameters conforming to ten variable sections of the human vocal system, that is tongue, lips etc., and has designed a system of ten circuits that filter through these ten syllabic frequencies when a voice signal is applied. The resultant signal has a frequency of low syllabic pattern. When this signal is received in a multi-oscillator circuit intelligible words are reproduced.

13. Dudley also invented an electronic device, patented June 21, 1938 No. 2,121,142 which could be operated by hand and made to produce intelligible words. In this invention the ten fingers of the hand controlled the syllabic frequency and a foot pedal controlled the volume. Other inventions based on the Dudley concept explained in patent No. 2,151,091 improved fidelity and modulated sounds of various types, however none the systems employ the techniques set out in this disclosure nor do they appear to have the fidelity or fabricating potential of this disclosure.

14. Prior patents which appear pertinent are:

2,121,142	Dudley	2,239,465	Dudley
2,151,091	Dudley	2,458,227	Vermeulen
2,183,248	Riesz	2,466,880	Dudley
2,243,089	Dudley	2,517,102	Flory
2,243,525	Dudley	2,635,156	Steinberg
2,243,526	Dudley	2,640,880	Aigrain
2,243,527	Dudley		

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